

USE OF TWO-DIMENSIONAL DIRECT-CURRENT-RESISTIVITY PROFILING TO DETECT FRACTURE ZONES IN A CRYSTALLINE ROCK AQUIFER NEAR LAWRENCEVILLE, GEORGIA

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Abstract. Two-dimensional direct-current resistivity (2D dc-resistivity) profiling was used to detect fracture zones in a crystalline-rock aquifer near Lawrenceville, Georgia. This work—which is a component of a ground-water resource investigation—was conducted by the U.S. Geological Survey in cooperation with the City of Lawrenceville. Profiling using 2D dc-resistivity methods is conducted by laying out an array of electrodes along a straight line and measuring an apparent resistivity. Electrical current is injected into the ground through two current electrodes and the voltage difference is measured at two potential electrodes. A multi-electrode system was used to collect apparent resistivity readings along the linear arrays. A commercially available switching unit was used to automatically select four electrodes along the array; this allowed the collection of several hundred to several thousand measurements along a single profile, depending on the configuration of the array and the number of electrodes used.

Three types of linear arrays were used for profiling. A dipole-dipole and a pole-dipole array appeared to show good horizontal and vertical resolution, whereas a Schlumberger array had poorer resolution, but provided more rapid data acquisition. The pole-dipole had the greatest depth penetration of the three arrays. The 2D dc-resistivity profiles were first conducted at the Rhodes Jordan Wellfield (fig. 1) where subsurface fracture zones have previously been characterized (Chapman and others, 1999). Bedrock resistivity imaging was conducted to a depth of as much as 55-meters (180 feet) using a 4-meter dipole-dipole array and 100 meters (328 feet) using a 4-meter pole-dipole array of 83 electrodes. An electrode spacing of more than 4 meters allows for a greater depth of penetration but with less resolution.

Resistivity profiling was also conducted at a well site where the underlying crystalline-rock aquifer is relatively unfractured. The profile exhibited higher resistivities than those for the Rhodes Jordan Wellfield. Results from the Rhodes-Jordan Wellfield and the unfractured well site provided guidelines that were used to conduct resistivity profiling at other sites being evaluated for ground-water resources in the vicinity of Lawrenceville.

LITERATURE CITED

- Chapman, M.J., Crawford, T.J., and Tharpe, W.T., 1999, Geology and ground-water resources of the Lawrenceville area, Georgia: U.S. Geological Survey Water-Resources Investigations Report 98-4233, 46 p.

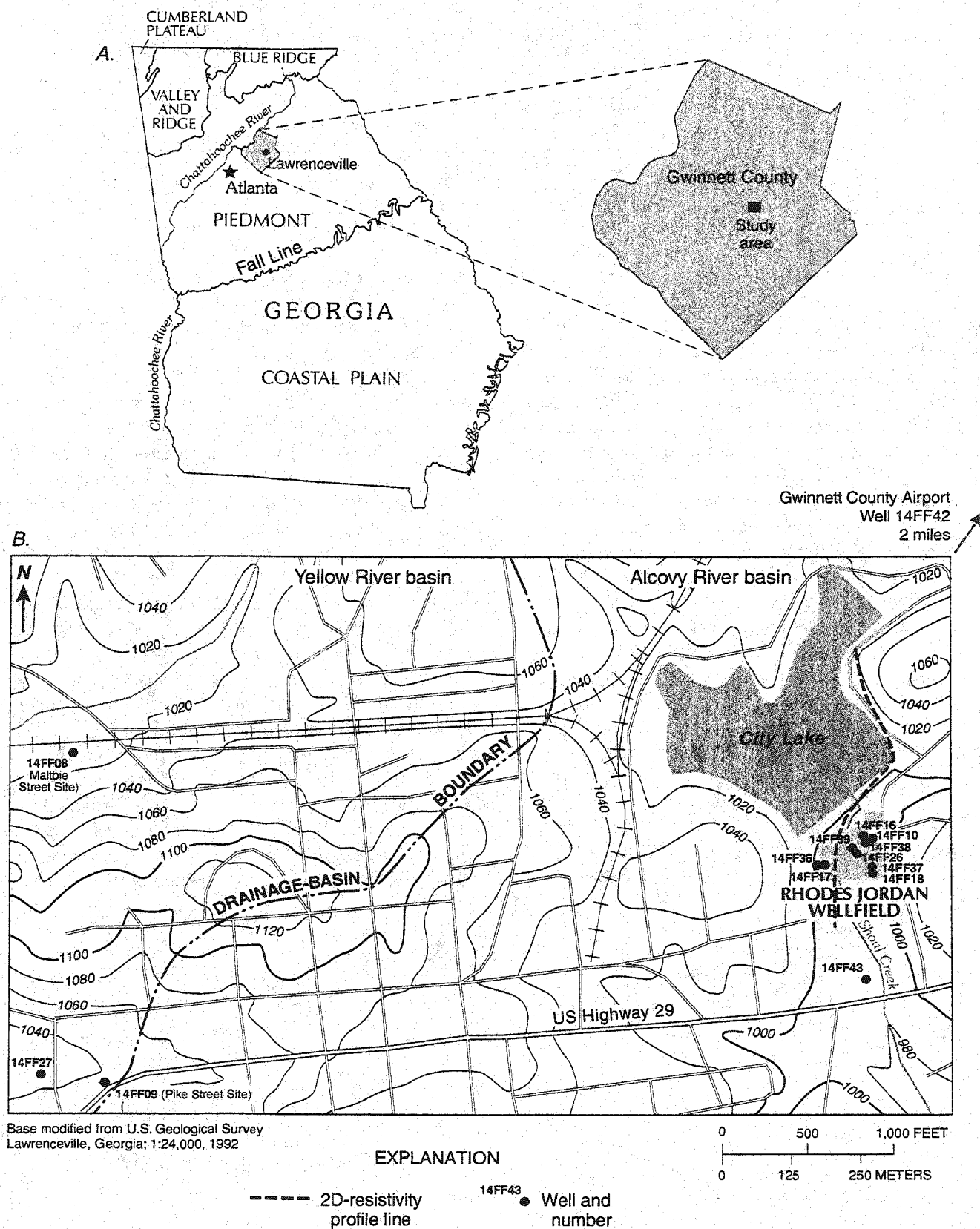


Figure 1. Location of (A) the study area in Gwinnett County and physiographic provinces in Georgia, and (B) the Rhodes Jordan Wellfield and observation wells in Lawrenceville, Georgia (modified from Chapman and others, 1999).